

Is it a Loss of Braking?



The LOSS OF BRAKING procedure memory items have to be applied in the extremely remote case of a failure of the braking system. In-service experience shows that inappropriate application of the LOSS OF BRAKING procedure may contribute to a risk of runway excursion.

This article recalls the conditions to apply the LOSS OF BRAKING procedure and highlights the risk of confusion by the flight crew when monitoring the aircraft deceleration during landing on contaminated runway.

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CASE STUDY 1

Event Description

An A320 aircraft was stabilized in final approach in CONF FULL. Autobrake MED was selected. The runway length was 3700 m. Autopilot and autothrust were both engaged. External conditions were combining snow showers and left crosswinds between 16 kt and 22 kt. The runway was reported as contaminated with snow.

Normal touchdown

① The touchdown was performed nominally at 140 kt ground speed (GS). The spoilers extended, ② MAX REV was applied, and the MED autobrake mode activated. ③ The **DECEL** light on the MED pushbutton switch transiently turned on and ④ then went OFF shortly after. The **ON** light remained ON.

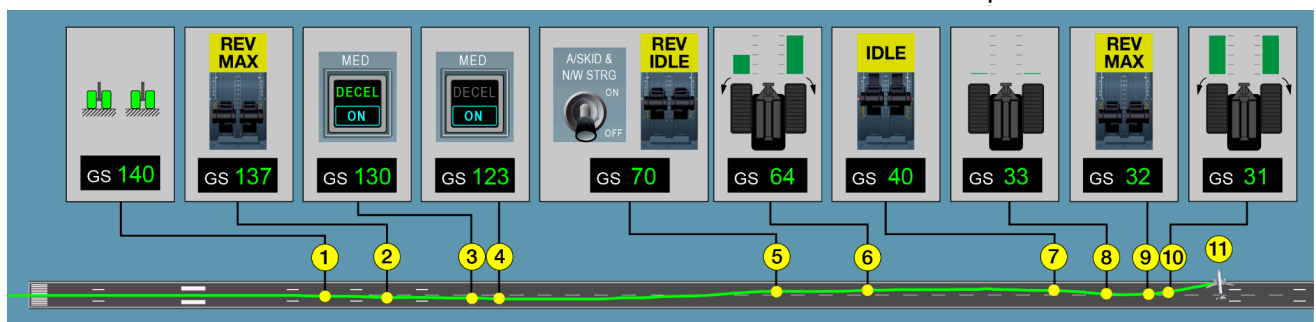
Application of the LOSS OF BRAKING procedure

⑤ At around 70 kt, the flight crew set the **A/SKID & N/W STRG** switch to OFF. The PF selected REV IDLE almost simultaneously. The aircraft was slightly diverging from the centerline toward the left edge of the runway.

Lateral runway excursion

⑥ The PF applied differential braking and rudder inputs to the right to try to recover the runway centerline. ⑦ The flight crew set the engine thrust levers to IDLE and ⑧ the PF released the brake pedals for some seconds. ⑨ They selected REV MAX again and ⑩ applied maximum pedal braking. The aircraft skidded, deviated from the centerline and ⑪ came to a stop at 90° from the centerline with the nose landing gear out of the runway.

(fig.1) Description of the first event (rudder inputs not illustrated)



Event Analysis

Autobrake and anti-skid correct activation

Analysis of the flight recorder data showed that the autobrake activated correctly and that the anti-skid function released the brake pressure several times to prevent wheel blockage due to the snow on the runway surface. This resulted in an average deceleration of 0.2 g, below the autobrake MED target of 0.3 g. As a consequence, the **DECEL** light briefly illuminated at the beginning of the landing roll.

Inappropriate application of the LOSS OF BRAKING procedure

The pilot report confirmed that the LOSS OF BRAKING procedure was applied with no further details provided. Airbus could not identify the reason for application of the LOSS OF BRAKING procedure because analysis of the flight recorder data showed the brake system functioned normally in autobrake normal braking mode until the flight crew switched the **A/SKID & N/W STRG** switch to OFF. A possible explanation is that the limited deceleration, due to the runway contamination with snow, may have been interpreted as a loss of braking function by the flight crew. ■

CASE STUDY 2

Event Description

An A321 was stabilized in final approach in CONF FULL. The runway length was 2400 m. The Captain was PF, autobrake MED was selected, autopilot was OFF and autothrust engaged. The airport was subject to heavy rainfall. The ATIS and tower reported WET runway condition. The ENG 2 thrust reverser was inhibited as per MEL item 78-30-01A. The flight crew planned to select REV IDLE during the landing roll.

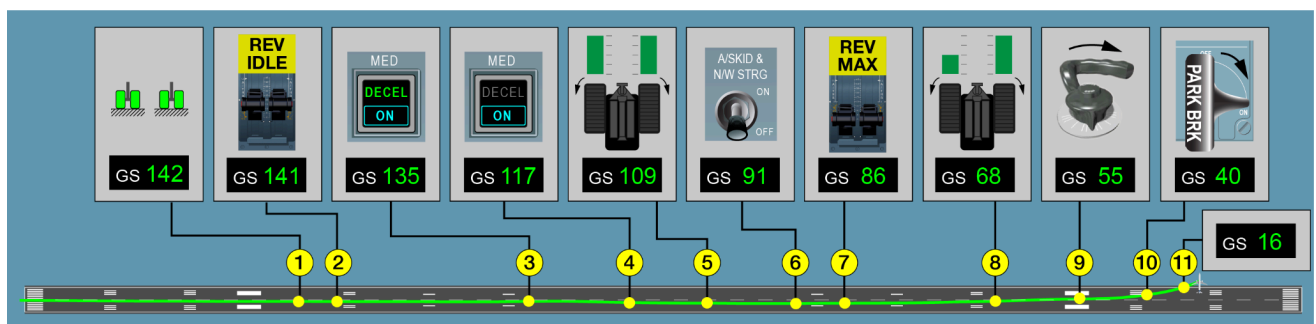
Nominal touchdown and autobrake activation

① The touchdown was performed nominally at 142 kt ground speed, with a 2 kt tailwind. The spoilers extended, ② REV IDLE was selected as planned, and the MED autobrake mode activated. The aircraft began to decelerate and ③ the **DECEL** light of the MED pushbutton switch illuminated.

Sudden deceleration drop followed by manual braking application

The flight crew then felt a sudden deceleration drop. ④ The PM observed that the **ON** light of the autobrake **MED** pushbutton switch was illuminated but the **DECEL** light had extinguished. He announced that the autobrake was lost. ⑤ The PF took over from the autobrake by applying full manual braking.

(fig.2) Description of the second event (rudder inputs not illustrated)



Application of the LOSS OF BRAKING procedure

The flight crew could not feel an increase in deceleration and decided five seconds later to apply the LOSS OF BRAKING procedure, ⑥ by setting the **A/SKID & N/W STRG** switch to OFF while the brake pedals were still fully deflected. This resulted in the instantaneous blocking of the four main landing gear wheels.

Aircraft skidding and REV MAX application

The aircraft skidded for 10 seconds and the PF applied right rudder input to maintain the aircraft's alignment with the runway. The PF then ⑦ set both reversers to REV MAX, whilst maintaining right rudder inputs.

Application of differential braking and nose wheel steering tiller inputs

⑧ While maintaining right rudder input, the PF started to apply differential braking by transiently releasing the left hand brake pedal. The aircraft veered to the left. ⑨ The PF applied full right inputs on the nose wheel steering tiller whilst differential braking was maintained. The aircraft quickly deviated toward the left hand edge of the runway.

Parking brake application and runway excursion

⑩ The flight crew applied the parking brake and ⑪ the aircraft exited the runway at 16kt before coming to a stop with the aircraft nose positioned at around 90° from the runway axis and 200 m from the end of the runway.

The flight crew set the thrust lever to IDLE and switched off both engines.



Event Analysis

Autobrake correct activation

Analysis of the flight recorder data showed the autobrake MED activated correctly.

Sudden change in deceleration

The sudden change in deceleration felt by the flight crew, and confirmed by the analysis of the flight recorder data, was due to the fact that the aircraft entered a portion of the runway with a very degraded runway friction performance, which is probably due to a significant layer of standing water. Performance computation based on the actual aircraft deceleration showed that **the runway condition dropped abruptly from an equivalent of GOOD to POOR** and remained POOR until the end of the landing roll. This runway condition was below the MED TO POOR condition that would be expected in the case of a runway contamination by standing water and used for landing distance computation (fig.3).

Significant anti-skid activation

The POOR runway friction caused the anti-skid function to be very active as it released the brakes several times to prevent wheel skidding. This reduced the deceleration rate below 80% of the target rate of the MED autobrake mode. This caused the **DECEL** light of the **MED** pushbutton switch to extinguish.

Inappropriate application of the LOSS OF BRAKING procedure

The sudden change in deceleration due to the uneven runway contamination, combined with the significant activation of the anti-skid function when manual braking was applied, led the flight crew to interpret the situation as a loss of braking and inappropriately apply the LOSS OF BRAKING.

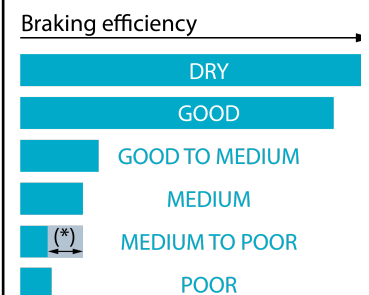
A/SKID & N/W STRG switch set to OFF with pedals fully pressed

The flight crew set the **A/SKID & N/W STRG** switch to OFF while the PF was pressing the brake pedals. This caused the wheels to lock instantly due to full application of the alternate brake pressure without anti-skid modulation.

Use of the nose wheel steering tiller

The attempt to use the steering tiller during the final seconds of the landing roll was ineffective because the nose wheel steering was unavailable due to the application of the LOSS OF BRAKING procedure. ■

(fig.3) Braking efficiency per reported braking action for landing distance computation (data from the FAA AC-25-32)



(*) Varies with speed due to aquaplaning

OPERATIONAL CONSIDERATIONS

The LOSS OF BRAKING procedure was introduced to cover an extremely rare **failure of the automatic switching to the alternate/emergency braking mode, in cases where the normal braking mode failed**. This may happen after a takeover from automatic to manual braking during landing or rejected takeoff. It may also happen during taxi. In-service experience has shown that the application of this procedure has been also efficient to cope with other kinds of braking system malfunction.

The LOSS OF BRAKING procedure consists in a **manual activation of the alternate braking mode without anti-skid (emergency braking mode on A350 and A380 aircraft)** using the **A/SKID & N/W STRG** switch on A320 family, A330 and A340-200/300 aircraft, or the **A-SKID** switch on A340-500/600, A350 and A380 aircraft, or the **BRK/ANTI SKID** switch on A300-600 and A310 aircraft. Ultimately, the procedure requests the application of the PARK BRK if the alternate/emergency braking also fails.

There is no equivalent LOSS OF BRAKING procedure on A220 aircraft because it has a different braking system design.

When to apply the procedure

The procedure must **only be applied during manual braking**, and only if the flight crew **does not feel any effect on the deceleration while pressing on the brake pedals**.

Consequences of the application of the LOSS OF BRAKING procedure

Applying the LOSS OF BRAKING procedure has non negligible consequences which depends on the aircraft type:

- **Loss of anti-skid function only on A300, A300-600, A310, A340-500/600, A350 and A380 aircraft.** This may reduce the braking performance of the aircraft, increase the risk of tyre burst, and potentially lead to runway excursion.
- **Loss of both the anti-skid function and the Nose Wheel Steering (NWS) on A320 family, A330 and A340-200/300 aircraft.** The braking performance may be reduced as well as the ground handling capabilities. The flight crew has to use the rudder at high speed and differential braking at lower speed for lateral control.



Wet and Contaminated Runway: Is it a Loss of Braking?

The two case studies described previously highlight the need to pay particular attention when landing on wet or contaminated runways in order to prevent inappropriate application of the LOSS OF BRAKING procedure. It is important that flight crews are aware of the behavior of the aircraft and its braking system when landing on wet or contaminated runways. This will prevent them from interpreting some normal phenomena linked to the conditions of the runway as loss of braking.

Lower deceleration in the case of a high anti-skid activity

The rate of deceleration perceived by the flight crew may be less on a contaminated runway than on a dry runway, particularly in the case of standing water or presence of other contaminants. There is a high probability that the anti-skid function will activate, reducing the perceived rate of deceleration. Even if it is the case, flight crew should be aware that **the anti-skid is designed to ensure the optimum deceleration rate adapted for the runway condition.**

Sudden deceleration change due to inconsistent contamination

The second case study showed the level of contamination of a runway, and therefore the runway condition, may vary along its length. This can lead to sudden changes in the rate of deceleration perceived by the flight crew, which may cause them to incorrectly determine they have a loss of braking.

Change in deceleration during transition from REV MAX to REV idle

Flight crews should also be aware that a sudden deceleration drop may be felt during the transition from REV MAX to REV IDLE, especially on wet or contaminated runways since the braking efficiency is reduced. This does not mean that the braking capability is lost.

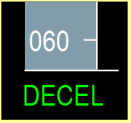
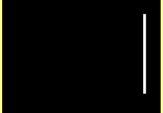
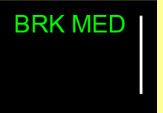
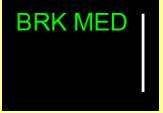


Autobrake **DECEL** light (A320/A330/A340) and **DECEL** message on the PFD (A320/A330/A340/A380)

On A320, A330 and A340 aircraft, if the **DECEL** light of the autobrake pushbutton switch is not illuminated, or extinguishes during the landing roll, this does not mean that the autobrake mode has failed. As explained in the FCOM description chapter, the **DECEL** light of the autobrake pushbutton switches is an **indication that the deceleration is above 80% of the target deceleration** of the selected braking mode. As a consequence, the **DECEL** light may not illuminate or extinguish during the landing roll, or during RTO, if the deceleration is reduced due to the runway condition and anti-skid activation.

The use of the MED mode on wet or contaminated runways increases the probability of an extinction of the **DECEL** light. The illumination threshold of the **DECEL** light may not be reached or only temporarily reached.

A display of a **DECEL** message below the PFD speedscales as well as a display of the autobrake mode on the FMA is available on A350 and A380 aircraft as well as on A320 aircraft equipped with EIS 2 standard S14 combined with BSCU L4-10 (MOD 157491) and SDAC H2E3 (MOD 151314), and subsequent standards. It is also available on A330/A340 aircraft equipped with EIS 2 standard L10 (MOD 205162) combined with BSCU S9D (MOD 205183), and SDAC C11 (MOD 203928), and subsequent standards.

	Autobrake mode OFF	Autobrake mode armed or engaged with deceleration below 80%(*) of the target deceleration rate	Autobrake mode engaged with deceleration above 80% of the target deceleration rate
Autobrake pushbutton switch (A320/A330/A340 only)			
DECEL on PFD speed scale (if installed)			
Autobrake mode on FMA (if installed)		 or 	

(*) Once illuminated, the **DECEL** light extinguishes if the deceleration diminishes below 60% or 70% of the target rate, depending on the aircraft type.

“**DECEL**” standard callout

As per SOP, the PM should make the “**DECEL**” standard callout **when they feel the deceleration and confirm it with the speed trend** on the PFD. **It is not based on the display of the **DECEL** light** of the autobrake pushbutton switch.

If no deceleration is felt, and it is confirmed on the PFD speed trend, the PF should call “**NO DECEL**”

Importance of the Arrival Briefing

Being prepared to manage the effects of a wet or contaminated runway on the aircraft deceleration **prevents any surprise effects** during landing that could lead to the flight crew inappropriately applying the LOSS OF BRAKING procedure.

During the arrival briefing:

- Discuss the runway conditions based on the available information
- Discuss the stop margin and the available deceleration means. **A drop in deceleration may be felt during the landing roll if the anti-skid activates, and when reversers are selected from REV MAX to REV IDLE,** and
- If the weather conditions are expected to change or in the case of significant precipitation at the airport, the flight crew should be prepared for a reduction of the braking performance. The case study n°2 showed us that a reported WET runway can quickly be contaminated with standing water, degrading the braking action from an expected MEDIUM to a MEDIUM TO POOR. The flight crew should therefore consider making a second computation of the landing distance with the worst condition possible. ■

TRAINING CONSIDERATIONS

The Flight Crew Training Standard (FCTS) manual recommends training the LOSS OF BRAKING procedure in the simulator in order to recall and apply the memory items with the associated callouts.

Train LOSS OF BRAKING at low speed and at high speed

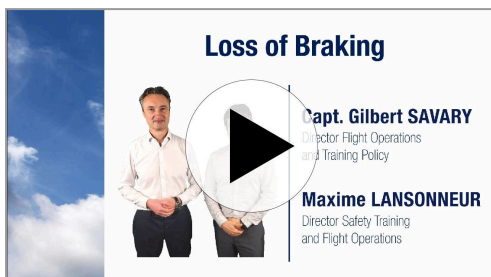
This can be performed at low speed such as during taxi, and also at high speed during landing. It is recommended to perform one of these scenarios with a startle effect situation.

Simulator limitation

Due to the limitation of the simulator ground model, **instructors must not mix a LOSS OF BRAKING with contaminated runway conditions**. Combining both situations would not be representative of the real aircraft behavior and would therefore give a negative training scenario. However, the specific behavior of the aircraft on wet and contaminated runways and possible confusion with a loss of braking should be reviewed during the briefing of the simulator session using the LOSS OF BRAKING section of the Flight Crew Techniques Manual (FCTM). ■



INFORMATION



A video dedicated to the LOSS OF BRAKING procedure is also available on the Airbus [Worldwide Instructor News \(WIN\) website](#).



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The LOSS OF BRAKING procedure was introduced to cover an extremely rare failure of the automatic switching to the alternate/emergency braking mode, in cases where the normal braking mode failed. It must only be applied during manual braking, and only if the flight crew does not feel any effect on the deceleration while pressing on the brake pedals.

To prevent inappropriate application of the LOSS OF BRAKING PROCEDURE, flight crew should be aware that, on contaminated runways, the perceived rate of deceleration may be lower than the rate of deceleration felt on dry runways. It is likely when there is activation of the anti-skid function.

Flight crew should also be aware that an uneven contamination of the runway, or the presence of standing water in some areas of the runway after a heavy rainfall, may cause sudden changes in the deceleration rate. This could cause the flight crew to incorrectly determine they have a total loss of braking.

Flight crew should also be prepared for the sudden change in the perceived rate of deceleration when they transition from REV MAX to REV IDLE, especially on wet or contaminated runways, since the braking efficiency is reduced.

It is essential to discuss these effects during the arrival briefing so that the flight crew will not be surprised should they perceive a sudden change in the rate of deceleration during the landing roll. This will prevent inappropriate application of the LOSS OF BRAKING procedure.

Training of the LOSS OF BRAKING PROCEDURE should be performed according to the Flight Crew Training Standard (FCTS) manual requirements and taking into account the limitations of the simulator ground simulation model.

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